

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit: To be Assigned

Examiner: To be Assigned

In Re PATENT APPLICATION Of:

Applicant : Minoru WATANABE

Appln. No. : Continuation of Serial No. 09/443,500

Filed : Herewith

For : METHOD AND APPARATUS FOR
FORMING RESIST PATTERN

Attorney Ref. : MAE 223 C1

PRELIMINARY
AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Preliminary to examination, please amend the application as follows:

IN THE SPECIFICATION:

Please amend page 1 of the specification to read as follows:

--This application is a continuation of application serial number 09/443,500, which was filed on November 19, 1999.--

IN THE CLAIMS

Please cancel claims 2-4 without prejudice or disclaimer to the subject matter recited therein.

Please amend claim 1 as follows:

1. (Amended) A method of forming a resist pattern on a semiconductor substrate, comprising:

forming a resist film on the semiconductor substrate;

supplying a developing solution on the resist film to remove the resist film, wherein a portion of the resist film remains on the semiconductor substrate; and

rinsing the developing solution from the portion of the resist film by a rinsing liquid to which ultrasonic vibration is applied.

Please add the following new claims 5-32.

--5. The method of Claim 1, wherein the ultrasonic vibration ranges from 40 kHz to 50 kHz.

6. The method according to claim 1, wherein the developing solution is an alkaline developing solution.

7. The method according to claim 6, wherein the alkaline developing solution includes tetramethylammonium hydroxide.

8. The method according to claim 1, further comprising:
exposing the resist film to light passing through a mask before supplying the developing solution.

9. The method according to claim 8, further comprising:
baking the resist film at a first temperature before exposing the resist film to the light; and
baking the resist film at a second temperature after exposing the resist film to the light, wherein the second temperature is different from the first temperature.

10. The method according to claim 9, wherein the second temperature is lower than the first temperature.

11. The method according to claim 1, further comprising:
irradiating the resist film with an electron beam using an electron beam lithography technique before supplying the developing solution on the resist film.

12. The method according to claim 11, further comprising:
baking the resist film at a first temperature before irradiating the resist film with the electron beam; and

baking the resist film at a second temperature after irradiating the resist film with the electron beam, wherein the second temperature is different from the first temperature.

13. The method according to claim 12, wherein the second temperature is lower than the first temperature.

14. The method according to claim 1, wherein the semiconductor substrate and the resist film formed thereon are submerged in a rinsing container, the rinsing liquid being supplied in the rinsing container.

15. The method according to claim 1, wherein the ultrasonic vibration is applied to the developing solution.

16. The method according to claim 1, wherein the rinsing liquid is pure water.

17. A method for fabricating a semiconductor device, comprising:
preparing a semiconductor substrate;
forming a resist film on the semiconductor substrate;
supplying a developing solution on the resist film for patterning the resist film,
whereby a patterned resist film is formed on the semiconductor substrate;
providing a rinsing liquid on the semiconductor substrate on which the patterned resist film is formed; and
applying ultrasonic vibration to the rinsing liquid.

18. The method according to claim 17, wherein the ultrasonic vibration ranges from 40 kHz to 50 kHz.

19. The method according to claim 17, wherein the developing solution is an alkaline developing solution.

20. The method according to claim 19, wherein the alkaline developing solution includes tetramethylammonium hydroxide.

21. The method according to claim 17, further comprising:
exposing the resist film to light passing through a mask before supplying the developing solution.

22. The method according to claim 21, further comprising:
baking the resist film at a first temperature before exposing the resist film to the light; and
baking the resist film at a second temperature after exposing the resist film to the light, wherein the second temperature is different from the first temperature.

23. The method according to claim 22, wherein the second temperature is lower than the first temperature.

24. The method according to claim 17, further comprising:
irradiating the resist film with an electron beam using an electron beam lithography technique before supplying the developing solution on the resist film.

25. The method according to claim 24, further comprising:
baking the resist film at a first temperature before irradiating the resist film with the electron beam; and
baking the resist film at a second temperature after irradiating the resist film with the electron beam, wherein the second temperature is different from the first temperature.

26. The method according to claim 25, wherein the second temperature is lower than the first temperature.

27. The method according to claim 17, wherein the semiconductor substrate and the resist film formed thereon are submerged in a rinsing container, the rinsing liquid being supplied in the rinsing container.

28. The method according to claim 17, wherein the ultrasonic vibration is applied to the developing solution.

29. The method according to claim 17, wherein the rinsing liquid is pure water.

30. A method of forming a resist pattern on a substrate, comprising:
forming a resist film on the substrate;
supplying a developing solution onto the resist film;
submerging the resist film formed on the substrate in a rinsing liquid; and
applying ultrasonic vibration to the rinsing liquid to rinse the developing solution from the resist film submerged in the rinsing liquid.

31. A method of forming a resist pattern on a substrate, comprising:
forming a resist film on the substrate;
supplying a developing solution onto the resist film;
providing a rinsing liquid onto the substrate so as to cover the resist film; and
applying ultrasonic vibration to the rinsing liquid to rinse the developing solution from the resist film submerged in the rinsing liquid.

32. A method of forming a resist pattern on a substrate, comprising:
forming a resist film on the substrate;
supplying a developing solution onto the resist film;
supplying the resist film formed on the substrate with a rinsing liquid; and
applying ultrasonic vibration to the rinsing liquid to rinse the developing solution
from the resist film submerged in the rinsing liquid.--

PRELIMINARY AMENDMENT

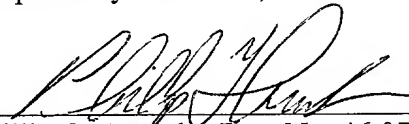
REMARKS

Claims 2-4 are cancelled. Claims 5-32 have been added. Please enter the Preliminary Amendment prior to calculating the filing fee. Examination of the amended application is respectfully requested.

Respectfully submitted,

December 26, 2001

Date


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MARKED VERSION OF AMENDED CLAIM

1. (Amended) A method of forming a resist pattern on a semiconductor substrate, comprising [the steps of]:

forming a resist film on the semiconductor substrate;

supplying a developing solution [onto] on the resist film to remove the resist film,
wherein a portion of the resist film remains on the semiconductor substrate; and

[submerging the substrate and the resist film formed thereon in a rinsing liquid kept in a rinsing tank; and

applying ultrasonic vibration to the rinsing liquid to rinse the developing solution from the resist film submerged in the rinsing liquid]

rinsing the developing solution from the portion of the resist film by a rinsing liquid to which ultrasonic vibration is applied.